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COTTONTAIL RABBITS IN RELATION TO TREES AND FARM CROPS.

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INTRODUCTION.

Among the serious pests in orchards and tree plantations are the several native species of rabbits. These animals do considerable damage to garden truck and other farm crops also, especially on lands recently opened to cultivation. North American rabbits belong to two general classes easily distinguished by their size and habits.

The larger forms¹ include the arctic and varying hares, or snowshoe rabbits, and the jack rabbits, and are found throughout nearly all of Alaska and Canada and in all the States west of the Mississippi except Arkansas and Louisiana. East of the Mississippi they inhabit the northern parts of Minnesota, Wisconsin, and Michigan, most of New York and New England, and southward in the Appalachian Mountains, parts of Pennsylvania, Maryland, and Virginia.

The smaller forms,² generally called "cottontail rabbits," occur in every State, but are absent from the greater part of Maine, the

¹ Genus *Lepus*.² Genus *Sylvilagus*.

NOTE.—This bulletin discusses the distribution and habits of cottontail rabbits and methods of controlling their ravages on trees and cultivated crops by means of trapping, poisoning, and supplying safeguards. For general distribution.

northern parts of New Hampshire, Vermont, New York, Michigan, Wisconsin, and Minnesota, and from the western parts of Washington and Oregon. In recent years they have extended their range northward in the New England States, New York, and portions of the West, and have invaded and occupied a considerable part of the Province of Ontario. In habits they differ materially from the larger rabbits. They live in copses and thickets more than in open fields. The young are born blind, naked, and helpless, while those of the larger rabbits have the eyes open, are partially furred, and active when born.

Rabbits of both genera, however, feed exclusively on vegetation, and are at times harmful to crops and especially to trees. Because of their size and great abundance in parts of their range, jack rabbits are by far the most destructive, but, except in a few places where they have been introduced, none are found east of the Mississippi. Epizootics (diseases which attack many animals at the same time) are an effectual natural check, and after such attack occurs, jack rabbits are usually so reduced in numbers that they are not troublesome again for several years.

Traps and other devices that are effective with cottontail rabbits do not always succeed with jack rabbits. The recommendations contained in this bulletin will, therefore, apply only to cottontail rabbits, but they may suggest methods that, with modifications, may be used against the larger forms.

HABITS OF COTTONTAIL RABBITS.

Cottontail rabbits (fig. 1) are so well known that little need be said of their habits. They breed several times each year during the warmer months, the litters averaging five or six young. The nest is usually placed in a hollow or depression of the ground, often in open fields or meadows. It is composed of dead grass and warmly lined with fur which the female pulls from her own body. The male rabbit takes no part in caring for the young, and the female weans them as soon as they are able to leave the nest. These animals breed so rapidly that in spite of many natural enemies, and of the fact that they are hunted for human food, they often become numerous enough to inflict serious losses on farmers and fruit growers in many parts of the United States (fig. 2).

Cottontail rabbits eat all sorts of herbage—leaves, stems, flowers, and seeds of herbaceous plants and grasses—and leaves, buds, bark, and fruits of woody plants or trees. They usually prefer the most succulent foods, as young shoots, tender garden vegetables, clover, alfalfa, and fallen ripe fruits; but they exhibit also a remarkable

delicacy of taste in their selection of certain varieties of cultivated plants and in their neglect of others of the same species. Prof. C. V. Piper reports that in Oregon rabbits ate Arabian alfalfa down to the ground, while they did little or no damage to other varieties grown in surrounding plats. Prof. C. A. Mooers, of the Tennessee Agricultural Experiment Station, reports similar observations in regard to their taste for soy beans, stating that they greatly relish the mammoth yellow variety and that it is practically the only one that suffers from their depredations. When favorite foods are absent rabbits resort to whatever is available. It is during summer droughts



FIG. 1.—Cottontail rabbit in its "form."

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or when deep snows cut off ordinary supplies that the animals attack the bark of growing trees or shrubs.

PROTECTION OF RABBITS.

Cottontail rabbits are valuable for food and afford excellent sport for gunners. In many States, especially east of the Mississippi River, they are protected as game. In fruit-growing and truck-farming districts farmers regard them with disfavor, and there is considerable rivalry between sportsmen and farmers to have their opposing views reflected in game laws. The interests of the two classes do not seriously differ, however, for when rabbits are closely

hunted losses from their depredations are usually reduced to a minimum. Still there is danger that in years favorable for their increase the animals may inflict serious injury to trees during severe winters.

Rabbits are protected (1915) by close seasons in States and Provinces as shown in Table I. Twenty-eight States, Alaska, and the Canadian Provinces not mentioned in the table do not protect rabbits of any kind. In the District of Columbia all shooting is pro-



FIG. 2.—Apple tree killed by rabbits.

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hibited except on certain river marshes. In Kentucky rabbits may be taken with dog, trap, or snare at any time, and the close season for shooting is evidently solely for the purpose of keeping gunners out of fields and woods during the two months immediately preceding the open season for quails. In Wisconsin 46 counties, mostly in the southern half of the State, have no close season for rabbits. In California only cottontails, or bush rabbits, are protected.

TABLE I.—Lengths of open season for rabbits or hares.

State or Province.	Begin- ning of open season.	Begin- ning of close season.	Length of open season.
			<i>Months.</i>
Maine.....	Oct. 1	Apr. 1	6
New Hampshire.....	Mar. 1	5
Vermont.....	Sept. 15	do.....	5½
Massachusetts.....	Oct. 12	do.....	4½
Rhode Island.....	Nov. 1	Jan. 1	2
Connecticut.....	Oct. 8	do.....	2½
New York.....	Oct. 1	Feb. 1	4
Long Island.....	Nov. 1	Jan. 1	2
New Jersey.....	Nov. 10	Dec. 16	1½
Pennsylvania.....	Nov. 1	Dec. 1	1
Delaware.....	Nov. 15	Jan. 1	1½
Maryland.....	Nov. 10	Dec. 25	1½
District of Columbia.....	Nov. 1	Feb. 1	3
Virginia.....	do.....	do.....	3
Kentucky.....	Nov. 15	Sept. 15	10
Ohio.....	do.....	Dec. 5	3
Indiana.....	Apr. 1	Jan. 10	9½
Illinois.....	Aug. 31	Feb. 1	5½
Michigan.....	Oct. 1	Mar. 2	5½
Wisconsin:			
6 counties.....	Sept. 10	Feb. 1	4½
13 counties.....	Oct. 10	do.....	3½
6 counties.....	Nov. 1	Jan. 1	2
Colorado.....	Oct. 1	Mar. 1	5
California.....	July 31	Feb. 1	6½
British Columbia.....	Sept. 1	Jan. 1	4
Ontario.....	Oct. 1	Dec. 16	2½
Quebec:			
Zone 1.....	Oct. 15	Feb. 1	3½
Zone 2.....	do.....	Mar. 1	4½
Newfoundland.....	Sept. 20	Jan. 1	3½
Prince Edward Island.....	Nov. 1	Feb. 1	3
Nova Scotia.....	Oct. 1	Mar. 1	5

In about half the States that have a close season for rabbits the laws permit farmers and fruit growers to destroy the animals to protect crops or trees. Such provision might well be incorporated in game laws of all States. For lack of it farmers have sometimes suffered severe losses, and not a few have been compelled to pay fines for trying to protect their property from rabbits. In States that protect rabbits it is well for the farmer to be acquainted with the game laws and in case of doubt to have a clear understanding with local and State game wardens before undertaking to destroy rabbits.

MEANS OF REPRESSING RABBITS.

NATURAL ENEMIES.

Among the agencies that help to keep down the numbers of rabbits few are more effective than carnivorous birds and mammals. These include large hawks and owls, eagles, coyotes, wildcats, foxes, minks, weasels, dogs, and cats. Eagles, the larger species of hawks, and all the large and medium-sized owls make rabbits a great part of their food. From the standpoint of the farmer and fruit grower these birds and certain carnivorous mammals are far more beneficial than harmful. On the other hand, poultry growers and sportsmen regard them as enemies to be destroyed whenever possible. In the absence

of such natural enemies, rabbits, as well as rats and mice, often become a menace to valuable crops. Indiscriminate slaughter of carnivorous birds and mammals should be suppressed whenever rodent pests are to be controlled.

HUNTING.

Hunting has been the most important factor in keeping down the numbers of rabbits in America. In some parts of the country the animals have been so reduced in numbers by shooting that sportsmen have invoked legislation to prevent their extermination. Shooting is undoubtedly the best method for hunting this animal. Ferreting is often impracticable, since our native rabbits do not habitually burrow; besides, the use of ferrets is forbidden by law in many States that protect the rabbit. Coursing with greyhounds is popular in the West, where the swifter jack rabbits are abundant. Cottontails are often chased with foxhounds, but the beagle is rapidly taking precedence as a favorite for hunting these animals, the gun being used to secure the game.

Where the country is sufficiently open for the purpose, the organized hunt, in which everyone who owns a gun is supposed to take part, is a good means of reducing the number of rabbits. These organized hunts are popular in the West, where they are also varied, in the case of jack rabbits, by what is known as the "rabbit drive." A large territory is surrounded by men and the animals are driven into a corral built of wire netting. While a few cottontails are sometimes included in the catch, these usually find refuge in open burrows or under cover of rocks or brush, so that this method is hardly applicable to them.

TRAPPING.

Rabbits are easily trapped or snared, and while these methods of taking them are slow, they are always feasible when cottontails infest woodlot, orchard, nursery, field, or garden. Many are caught in old-fashioned box traps set with a figure-4 trigger with cord attached to hold up the box lid.

An improvement on this familiar trap, widely used in the Middle West, and often called the Wellhouse¹ trap, is a box 21 inches long and about 6 inches high and 4 inches wide (inside measurements) made of 6-inch fence boards, preferably old ones. The box is closed at the rear and has a wire door in front which swings inward from the top, a cleat at the bottom preventing its opening outward. The trap is set and the wire door kept open by a wire trigger-rod held in place by two staples in the top of the box. The trigger-rod is bent downward into a loop or figure 8 near the rear of the trap. As the

¹ After the late Mr. Fred Wellhouse, of Topeka, Kans.

rabbit enters the trap and crowds into the back part it presses against the loop, moves the trigger-rod backward and is imprisoned as the wire door is released and falls. Bait may be used but is unnecessary, since cottontails frequently take refuge in dark places from enemies or inclement weather.

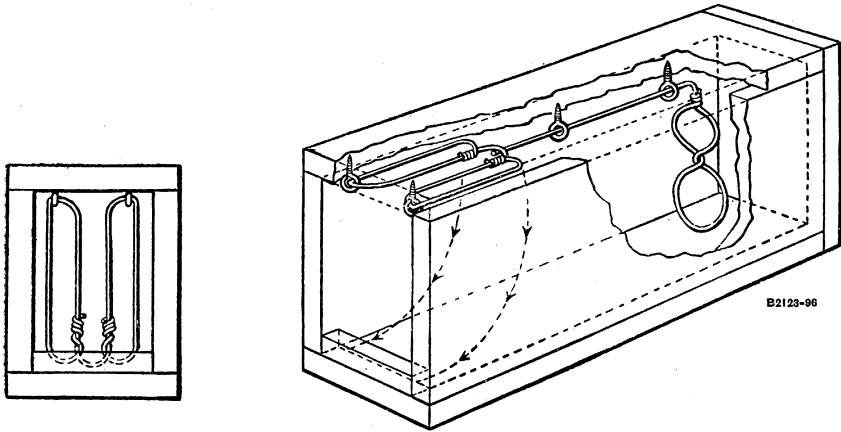


FIG. 3.—Details of a Wellhouse rabbit trap.

The materials needed for making a Wellhouse trap are: Four boards 1 by 6, 21 inches long, for the sides; a piece 1 by 6, 8 inches long, for the back; a small cleat for the door stop; $28\frac{1}{2}$ inches of wire for the door; 22 inches of wire for the trigger; 4 small staples for hanging the door and trigger; and nails (fig. 3).

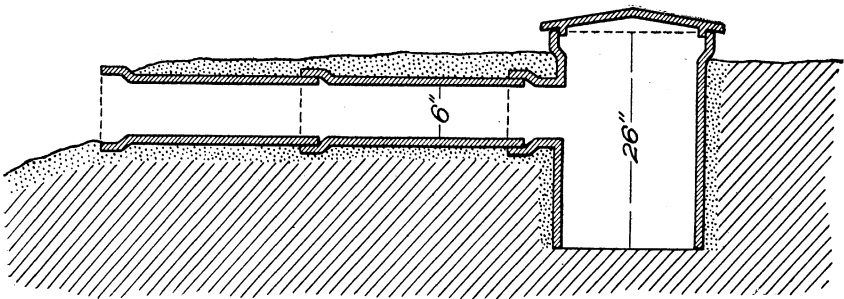


FIG. 4.—Cross section of a Walmsley tile trap for rabbits.

Mr. J. M. Walmsley recently sent to the department photographs and a description of a permanent rabbit trap made of sewer tile and used on his and other farms in Kansas (fig. 4). A 12 by 6 inch "tee" is set with the long end downward and buried so that the 6-inch opening is below the surface of the ground. Two lengths of 6-inch sewer pipe are then connected horizontally with the opening. Soil is

placed over the joints to exclude light. The upright tile should be fitted with a tight removable cover—Mr. Walmsley uses old harrow disks for the purpose. The projecting end of the small tile is surrounded with rocks, brush, or wood, so as to make the hole look inviting to rabbits (fig. 5), and that they may appropriate the den as a place of concealment and shelter. A number of these traps in various places, and especially in the vicinity of the orchard, have kept Mr. Walmsley's farm comparatively free of rabbits. Rabbits occupy these tile traps, go in or out at will, and may be captured when desired. Whenever Mr. Walmsley visits his traps he is accompanied by a trained dog that locates the trapped animals. The cover is lifted from the upright tile and the rabbit captured by hand; if it



FIG. 5.—A Walmsley tile trap in use.

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bolts from the side opening it is caught by the dog. A short pole fitted with a 5-inch wooden disk may be inserted in the side opening to prevent escape.

These traps are especially suitable for open lands and prairies, where rabbits can not find many natural hiding places. Built on waste land, they may become a permanent part of the farm equipment and will cost nothing for repairs from year to year. Their first cost may be greatly reduced by use of second-grade or even broken tiles. If one wishes to poison rabbits, the baits may be placed inside these traps and domestic animals or birds will not be endangered. The Walmsley trap also furnishes an excellent means of obtaining rabbits for the table or even for market without damaging them by shooting.

POISONING.

Poison for killing rabbits has been used in the West with considerable success. Only in exceptional cases, however, is its use advisable in States that protect rabbits. The most favorable season for using poison is in winter or after a long drought in summer has made green food scarce. In some localities summer poisoning is interfered with by crickets or grasshoppers consuming the bait.

The following method is adapted for general use: Insert crystals of strychnine or powdered strychnine in pieces of apple or melon rind and place these baits at intervals along rabbit runs or paths. **Take care to put the poisoned baits where children and domestic animals can not get them.** Where no well-defined runs are visible in orchards, artificial ones may be made with a narrow drag or scraper. Along such runs or the dead furrows of plowed fields rabbits habitually travel. Baits may be placed on the ground or elevated on short sticks along the path, and should be looked after with care. **Any baits left after poisoning operations are finished should be destroyed.**

For poisoning rabbits in winter or during droughts the following formula is recommended: Good oats, 12 quarts; powdered strychnine, 1 ounce; laundry starch, 1 tablespoonful; soda (bicarbonate), 1 ounce; saccharine, $\frac{1}{8}$ ounce; water, 1 quart. Mix the starch with $\frac{1}{2}$ pint of cold water. Pour this into $1\frac{1}{2}$ pints of boiling water and continue the boiling for a minute or two until the starch is clear. Mix the dry strychnine and soda in a small pan and sift it over the hot starch, stirring thoroughly to form a smooth paste. Add the saccharine and stir again. Pour the mixture over the oats in a metal tub, mixing until all the grain is wet. Allow the oats to dry before distributing. Not over a tablespoonful of the grain should be put in a single bait and this should be scattered considerably. A little alfalfa hay will help attract rabbits to the poisoned grain. This poison is recommended for use when snow covers the ground. It is effective against both cottontails and large rabbits.

Partly ripened heads of barley or wheat soaked in a solution of strychnine and saccharine or coated with the starch-strychnine solution just described have also proved effective baits for rabbits, but **great care must be exercised in using them, as they are likely to be eaten by live stock.**

Cottontail rabbits may be poisoned in winter by baiting them with twigs cut from apple trees and dipped in or thinly coated with the starch-strychnine poison. These twigs are scattered along rabbit trails and are effective against both meadow mice and rabbits. They are less dangerous to domestic animals than grain baits.

BACTERIAL DISEASES.

The fact that when rabbits become excessively abundant in any locality epizootic diseases often destroy them in large numbers has led many people to expect that a micro-organism would be found which would afford a ready means of rabbit control. The Biological Survey receives many applications for such bacterial preparations. In reply to all of them it has been necessary to state that thus far all attempts to spread contagious disease artificially among wild rabbits have failed to give practical results.

PROTECTION OF CROPS FROM RABBITS.

Complete extermination of rabbits in any part of the United States is not desirable, even if possible. They should be reduced in numbers only sufficiently to secure comparative safety to crops, and before active wholesale destruction of the animals is attempted the possibility of crop protection by other means should be carefully considered. In many cases one of these means would probably be the more economical method.

RABBIT-PROOF FENCES.

When rabbits are abundant and the area to be protected is not too great, a rabbit-proof fence may profitably be used. Woven-wire netting is recommended for this purpose. This material is in general use, not only against the rabbit pests of Australia and Europe, but in our own country against both large and small rabbits. As our species burrow less than the European rabbit the requirements for rabbit proofing a fence here are not so great. Even the cottontails, when driven by hunger, will dig under a fence, but this may be prevented either by use of wire with close barbs in contact with the ground or by plowing a furrow against the lower edge. A netting of galvanized wire with $1\frac{1}{2}$ -inch mesh and $2\frac{1}{2}$ to 3 feet high is a sufficient barrier against cottontails. Where snow is infrequent market gardeners and nurserymen use a 2-foot fence, but in the North they prefer to use a netting $3\frac{1}{2}$ feet wide, and to turn from 4 to 6 inches of the lower edge flat and cover it with soil. Netting made of No. 20 wire costs from 25 to 35 cents a rod. Heavier netting slightly increases the cost, but adds to the durability of the fence. Where lumber is cheap, a picket fence or one made of laths and wire is practicable. When deep snows fall and drifts form, fences offer no protection to crops against rabbits.

TREE PROTECTION.**WASHES.**

Many devices for protecting trees from rabbits have been recommended, the majority of which are paints, smears, or washes supposed to be distasteful to the animals. Many are not sufficiently

permanent to afford protection for an entire winter, and most of those that are lasting are injurious to trees. Coal tar, pine tar, tarred paper, and oils, under certain conditions, are dangerous to young trees. Carbolic acid and other volatile substances afford only temporary protection, and must be renewed too often to warrant their use. Bitter substances, like commercial aloes and quassia, are useless against rabbits.

The most promising simple washes for protecting large trees from rabbits are those containing lime mixed with sulphur or copperas in various combinations. Lime alone is not sufficiently permanent, especially where much rain falls. When mixed with sufficient copperas it has a deep green color and sticks much better. The lime-sulphur wash commonly used to destroy San Jose scale in winter has often proved successful as a rabbit repellent, but its lack of adhesive qualities often makes it fail. The defects may be partly corrected by mixing salt, soap, or a cheap glue with the lime and sulphur while the wash is still hot.

A poisoned wash of starch and glycerin, tried during the winter of 1913-14 in Idaho by a field agent of the Biological Survey, gave excellent results in protecting young orchards from jack rabbits, and would probably be equally effective where cottontails are concerned. The wash is prepared as follows:

Dissolve 1 ounce of strychnine (sulphate) in 3 quarts of boiling water. Dissolve $\frac{1}{2}$ pound of laundry starch in 1 pint of cold water. Pour the starch into the vessel containing the strychnine and boil the mixture a short time until it is clear, adding 6 ounces of glycerin and stirring thoroughly. When it is cool enough apply with a paint brush to the tree trunks.

The glycerin and starch adhere well and form a thin coating to the bark. Rabbits attacking the trees will be quickly killed. In the Idaho experiments none of the trees were damaged badly enough to affect their growth and all the rabbits in the orchards were destroyed. The method is well worth trying; but **care should be taken not to endanger domestic animals.**

MECHANICAL CONTRIVANCES.

Among the best mechanical contrivances for protecting trees from rabbits are cylinders of woven wire netting. Poultry netting of 1-inch mesh, made of No. 20 galvanized wire, will answer every requirement. Rolls 18 inches wide are used for cottontails, and the material is cut into 1-foot lengths. One of the sections is rolled into cylindrical shape about the trunk of each tree and fastened at several places by bending and twisting the projecting ends of wire. No other fastening is needed, but stakes or spreaders may be used to prevent rabbits from pressing the wire against the bark and doing

injury through the meshes. These guards should be left on the trunks, and will last as long as the trees require protection. The cost of material is less than 2 cents for each tree. These protectors may vary in size to suit the requirements of any particular locality or kind of tree. They may be adapted to protection from the larger rabbits by using wider rolls and to protection from both meadow mice and rabbits by using wire of finer mesh and by pressing the lower edges into the ground.

Veneer and other forms of wooden protectors are popular, and have several advantages when used for cottontail rabbits. When left permanently upon the trees, however, they furnish retreats for insect pests. For this reason they should be removed each spring. While the labor of removing and replacing them is considerable, they have the advantage when pressed well into the soil of protecting from both mice and rabbits. They cost from 60 cents a hundred upward, and are much superior to building paper or newspaper wrappings. The writer has known instances where rabbits tore wrappings of building paper from apple trees and in a single night injured hundreds. "Gunny-sack" and other cloth wrappings well tied on are effective protectors. Cornstalks furnish a cheap material for orchard protection when cut into lengths of 18 to 20 inches, split, and tied with the flat side against the tree, so as fully to cover the trunk. However, they last but one season and putting them in place involves much labor.

OTHER MEANS.

Few of these methods for the protection of individual trees in orchards or elsewhere are applicable to young woodlands or forest plantations where trees grow close together. In these cases the only remedy is the destruction of the animals or their exclusion by wire nettings.

Clean cultivation, generally, possesses advantages in preventing rabbit depredations, since it reduces the number of places of refuge for the animals; but rabbits go long distances in search of food, especially in winter, and clean cultivation can not be applied on the western plains, where dense windbreaks are essential to successful orcharding.

Feeding rabbits in winter to prevent their attacks on orchards has been practiced successfully, on the theory that it is cheaper to feed than to fight them. One plan is to leave the winter prunings of apple trees scattered about the orchard. Another is to furnish corn, cabbage, or turnips in sufficient quantity to provide food for the rabbits during cold weather. These methods have considerable merit, particularly the first, which seems to give satisfactory results when both mice and rabbits are present.